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Michael Cavanagh

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Michael Cavanagh

Department of Education, Macquarie University, Australia

Abstract

This article reports on students' experiences of lectures which included many opportunities for **active engagement through cooperative learning activities**. At the end of a 13-week semester-long unit, 113 students completed a questionnaire which contained five open-ended questions focusing on the extent to which the students thought that the lecture activities helped them to learn and understand the course content and to maintain their interest and attention during the sessions. **Results indicate that students valued the mix of traditional lecturing and cooperative learning tasks, particularly the variety of activities, the opportunities for small-group and whole-class discussions, the clear focus on one or two central ideas, and the authenticity of the tasks.**

Keywords

cooperative learning, engagement, lecturing, mathematics education, teaching styles

Engagement in lectures

There are many advantages associated with cooperative learning and active student engagement in lectures. Students who contribute enthusiastically in lectures retain information for longer than if they simply see or hear it (Fry et al., 1999; Lujan and DiCarlo, 2006; McCarthy and Anderson, 2000). Active learning has also been linked to higher student motivation (Machemer and Crawford, 2007) and increased confidence with class materials (Cherney, 2008). Smith et al. (2005) found that active student participation in lectures led to better student attitudes and improved critical thinking skills. Similarly, Justice et al. (2007) report that inquiry-based approaches in which students were provided with opportunities to think critically and reflectively helped them become self-directed learners who were better able to weigh evidence from a variety of sources, synthesize information, and communicate their ideas. Biggs (1999) notes that teaching which seeks to elicit a response from students by questioning or through collaborative problem-solving tasks can develop deep approaches to learning in which students focus on understanding concepts to relate new ideas to previous knowledge, experiences and themes rather than simply memorizing facts. This *experiential learning* 'has a quality of personal involvement – the whole person in both feeling and cognitive aspects being *in* the learning event' (Rogers, 1983: 20).

Corresponding author:

Michael Cavanagh, Department of Education, Macquarie University, North Ryde 2109, Australia

Email: michael.cavanagh@mq.edu.au

Lectures continue as the dominant form of university instruction (Lammers and Murphy, 2002). Active engagement and cooperative student learning can take place in lectures (Jones, 2007), principally by breaking up the lecture for a brief time (Stead, 2005). Various techniques such as short writing tasks, small-group discussions and sharing in pairs, or even rest breaks not only help students re-engage with the content (Young et al., 2009), but also encourage students to take greater responsibility for their learning (Niemi, 2002). Moreover, the benefits of active learning in lectures are maximized when tasks are authentic and reflect how knowledge is used in real life, when students have opportunities to adopt multiple roles and consider different perspectives, and where students are required to articulate their thinking and reflect on the ideas of others (Herrington and Herrington, 2006).

The growing popularity of web-based lecture technologies (WBLT), such as podcasting of digital audio and video files to record and transmit lectures, is also having an influence in higher education (McGarr, 2009). Gosper et al. (2008) found that many students believed that WBLT could enhance their learning by offering greater flexibility or by helping them make up for a lecture they had missed. However, the authors also noted concern among academics about the impact of new technologies on lecture attendance since students might feel that they could learn just as well by listening to a lecture recording as from attending the lecture in person. Other studies (Larkin, 2010) contradict this fear by reporting that students will continue to attend lectures even when the sessions are recorded and available for download.

Much of the research on active engagement of students in lectures has focused on cognitive outcomes and whether or not these approaches have led to improvements in student learning (Hu et al., 2008). The results have been generally favourable, but some studies indicate that cooperative learning in lectures is of little value or can even be detrimental. For example, Huxam (2005) noted a generally weak positive influence of interactive learning tasks in lectures on science students' recall and learning. Vreven and McFadden (2007) found that students undertaking a three-week general psychology course derived no additional benefit from cooperative learning activities in lectures because the course was time-compressed with a large number of students, while van Dijk et al. (1999) concluded that the skills and preferences of the lecturer were more crucial than the provision of cooperative learning activities.

The mixed results therefore indicate the need for further research into how best to integrate interactive tasks in lectures (Huxham, 2005; Murphy and Sharma, 2010). In addition, Hodgson (1997) notes that there 'are very few studies which attempt to look at lectures as they are experienced by students' (Hodgson, 1997: 159). The present study aims to fill this gap in the research by describing an approach to incorporating active student engagement and cooperative learning in lectures, and by specifically focusing on students' experiences of these lectures. The study examines how students experienced the 'lectorials' by investigating students' perceptions of the extent to which the activities for cooperative learning and active engagement improved their understanding of the content presented and helped them maintain their interest and attention during the lectorials.

Context

The study took place during a second-year unit in mathematics education at the author's university. The unit, EDUC258, is a compulsory unit and is convened by the author, who gives a 50-minute lecture each week of the 13-week semester. When the research was undertaken in June 2009 the unit had an enrolment of 147 students, of whom 18 were enrolled externally. Student attendance is not monitored since all of the lectures are recorded and available for audio streaming from a

restricted-access website shortly after their conclusion. External students download the recordings rather than come to lectures on campus, while internal students can choose whether to attend in person, listen via the internet, or both.

Tutorials in EDUC258 are designed to engage students in collaborative problem-solving tasks which allow for a variety of solution strategies and draw on a wide range of concepts and skills. In lectures, rather than sit passively and listen to the lecturer deliver all of the content, students have many opportunities to engage in activity and to reflect on their own educational experiences in learning.

Lectorials

The lectures in EDUC258 are referred to in students' course materials and during the sessions as 'lectorials' – a combination of lecture and tutorial – to emphasize their interactive nature. Lectorials are structured so that the activities change every 10 to 15 minutes, so there are typically two or three cooperative learning tasks interspersed between some traditional lecturing in each session. The key feature of the design of the lectorials is the inclusion of segments of traditional lecturing blended with activities designed to engage students actively in their learning and provide sufficient time for them to process ideas.

Sometimes the lecturer presented his ideas before students were given a related task which allowed them to think more deeply about what they had heard, and on other occasions the cooperative learning activity was used as a prelude to the lecture-style delivery so that students had already started thinking about the issue and were more receptive to the lecture content which followed. For instance, a short video excerpt of a mathematics lesson could be shown as the catalyst for student thinking about a particular issue before the lecturer reviewed it. Stimulus materials, including case studies of teaching episodes or hands-on classroom learning activities using concrete materials, might be provided for students to complete in pairs or small groups prior to sharing their ideas more widely. Alternatively, whole-class discussion might follow a lecturing phase to complement the lecture presentation so that students could reflect more deeply on the lecturer's ideas. In either case, the lectorials were deliberately intended to combine transmissive delivery of content with activities and experiences that provided opportunities for students to engage with each other and discuss the content.

Method

The current study adopts a practitioner research framework in which the objects of research are the researchers' own educational practices, their understandings of these practices, and the situations in which they practise' (Carr and Kemmis, 1986: 180). The study uses a student questionnaire to investigate students' perceptions of the value and importance of the active learning and cooperative activities they undertook during lectorials.

Student questionnaire

The questionnaire (see Appendix) contained five questions and was designed so that students could complete it in about 10 minutes. The first question asked students whether the lectorial activities had helped them learn and understand the unit content. Question 2 focused on the extent to which the lectorial activities had assisted students in maintaining their interest and attention during the sessions. Question 3 asked students if the number and frequency of cooperative learning activities

during lectorials was appropriate, and question 4 provided an opportunity for students to suggest any other lectorial activities which could be included in future offerings of EDUC258. The final question was open-ended for students to add any further comments if they wished to do so. The students' responses to Questions 1 and 2 are the main focus of the research reported here. Responses to the other three Questions are only discussed to the extent that they address the research focus areas.

Sample

All students who attended the final lectorial for EDUC258 in June 2009 were invited to complete the questionnaire anonymously at the start of the class and return it as they left the lecture theatre. The students were predominantly female, aged in their early twenties, and enrolled in a four-year combined Bachelor Degree and Diploma of Education. These students typically complete EDUC258 in the second year of their studies. Mature-aged students, who already have a three-year Bachelor Degree and are completing their teaching qualification, comprise about one quarter of the EDUC258 cohort. In total, 114 of the 129 internally enrolled students returned their questionnaire, representing 88% of the internal student population. However, one student turned in a blank questionnaire so there were 113 questionnaires available for analysis.

To help ascertain the reliability of the questionnaire responses, students were asked to nominate how many of the lectorials they had actually attended (as opposed to listening to the recordings) during the semester. The results indicate that 94 students, or approximately 83% of those who returned the questionnaire, reported that they had attended at least 11 of the 13 lectorials.

Analysis

The analysis focused on the questionnaires from the 94 students who had missed at most two of the lectorials since it was felt that they were better able to provide meaningful feedback on their experiences. Student responses for each question were analysed separately. First, a close reading of the questionnaires led to the development of a preliminary list of codes for categorizing students' responses in each question. The questionnaires were then read a second time, question by question, and the responses were classified using the preliminary list of codes. Occasionally, no code from the list was deemed suitable to represent the student's answer and so a new code was created. The questionnaires were then read a third time to collect illustrative examples and quotations related to each of the two focus areas of the research.

Results

The results for the students' experiences of the cooperative learning tasks and active engagement activities are reported in two sections which reflect the main focus of the student questionnaire: (i) understanding the content, (ii) maintaining interest and attention.

Understanding the content

All but three of the 94 students who had attended at least 11 of the 13 lectorials agreed with the statement in Question 1 that the cooperative learning activities in lectorials had helped them learn and understand the content of the unit. The students who disagreed stated that they felt the cooperative tasks reduced the time available for transmission of unit material and thus there was too little content delivered or that the tasks did not sufficiently relate to mathematics teaching.

Students offered many explanations for why they thought that the cooperative learning activities had helped them understand the unit content. The most common reasons related to the ways in which the lectorials provided numerous opportunities for students to become active participants in their learning. As one student commented, 'You have to think about what is being taught, building a deeper understanding rather than just receiving information passively.' In fact, many students contrasted their participation in EDUC258 lectorials with the traditional lectures they had experienced in other units, making comments such as 'Continuous lecturing can easily become boring but by participating we are engaged and involved with the content' and 'I tend to remember lectures that require interaction.' The range of lectorial activities also addressed the diverse learning preferences of some students: 'In this unit we get to be involved and personally I am not an audio learner – I tend to learn better visually or kinesthetically so I have found this setup extremely helpful.'

Active involvement was often associated with the small-group and whole-class discussions which occurred regularly during lectorials. Students described these exchanges as important because they provided extended opportunities for them to formulate and express their opinions and to critique the ideas presented by the lecturer. One student put it succinctly as follows: 'Involvement in lectorials→critical thinking→sharing opinions'. Moreover, students recognized that discussions promoted a much deeper analysis of the subject matter than if they had simply copied down notes: 'Discussions helped me understand certain things I wouldn't have understood just by reading them.'

Talking together about the unit content also exposed students to alternative views and opinions, thereby advancing each person's understanding. As one student wrote, 'By engaging with my peers I found it helpful in understanding concepts, and hearing other class mates' responses opens different perspectives.' Students also recognized that listening attentively during the discussions allowed them to 'see how other people would approach these activities'. They could hear 'alternative ways of thinking about the content' such that each person was no longer 'limited to your own possible understanding'.

Some students noted that, even though they were apprehensive at first about sharing with peers in the lectorials, they persevered because of the benefits which they gained as a result of their participation: 'Sometimes just to talk to the person next to me, though uncomfortable at first, allowed me to lift the level of my own learning.' Student-to-student interactions, either with a partner or in small groups, were found by many to 'really help illustrate a point and make it much easier to understand', principally because they were 'discovering something for ourselves' in a supportive learning environment. The concepts presented in the lectorials were reinforced through constant repetition during the small-group and whole-class discussions, and hearing from peers in their own words gave the ideas additional credence.

A number of students commented on how they perceived their academic development as the semester progressed. Some students emphasized that, as they articulated their thinking and listened to the views expressed by their peers during the lectorials, they became more acutely aware of how much of the material they comprehended: 'The activities help me generalize my understanding [and] also makes me realize how much I know and understand.'

Another aspect which students linked to their ability to understand the unit content was the structure of lectorials. Each lectorial session was an in-depth analysis of one or two core ideas, often framed in terms of a key focus question for students to explore in detail using a variety of activities. Students reported that this organized and coherent approach allowed them to follow closely the lectorial's intellectual thread so that they could readily see how each cooperative

learning activity was related to the traditional lecturing phases of the session. The tight focus of the lectorials also provided extended opportunities for students to think more deeply about a specific aspect of the unit content and develop their own ideas in response to it. As a result, not only were the discussions more robust, but students also recognized that they were better able to absorb and process the material: 'Lectorials did not try to cram too much information allowing me plenty of time to digest everything' which, in turn, made the sessions 'easier to comprehend and follow'.

Maintaining interest and attention

All of the respondents agreed that the lectorial activities had helped them maintain interest and attention during the sessions. The main reason cited by students was the variety of activities on offer. The 'good balance between student involvement and teacher explanations' and the relatively short period of time devoted to each activity also added to the feeling that lectorials were full of variety. Students mentioned that the diversity of activities helped them stay focused because the activities 'broke up the time' and 'kept me alert and thinking' by 'involving us'. Hence, the most crucial element in maintaining student interest and attention during lectorials was the mix of traditional lecturing and cooperative learning tasks for students to think about on their own, discuss with those seated near them, and then share in the whole-class forum. Students indicated that the lectorials contained about the right mix of knowledge and theory transmitted by the lecturer, combined with self-directed, cooperative learning experiences that afforded them time to process the ideas and helped them to clarify their thinking.

The extended opportunities for students to engage more deeply with the unit content by sharing ideas and asking questions had an important bearing on how students prepared for the lectorials: 'I have looked forward to these lectorials in particular and so have been more motivated to participate and prepare.' Students soon realized that if they came to the lectorials then they would be required to contribute in discussions and other cooperative learning tasks and this encouraged them to look over the relevant readings and lectorial slides (contained in course notes which students were asked to purchase at the start of the semester): 'Having the lecture slides beforehand and the readings gives an idea of the focus of the session and helps me prepare for it.' The students' willingness to become involved in activities also helped them remain focused and attentive during the sessions: 'Through engagement and forcing me to do the activities [it] made me learn and I became more interested in what you had to say as well as the input from other students.' Active student engagement with peers in the cooperative tasks also made the sessions more memorable and raised issues for students to think about before the next lectorial: 'The activities always leave me with something to follow up on throughout the week'.

There were other comments from students which referred to the lecturing style adopted in the sessions. Students stated that the 'logical flow' in the activities combined with 'helpful explanations' delivered in a 'well-spoken, clear and concise' manner all contributed to maintaining their interest, even during the traditional stand-and-deliver phases of the lectorials.

Another feature of the lectorial activities which students cited in response to the second part of the questionnaire related to the ways that the cooperative learning tasks afforded them regular opportunities to analyse classroom vignettes (either as written case studies or short video excerpts). Thus students could simultaneously reflect on their previous practicum experiences and also project themselves into their future roles as fully qualified mathematics teachers. In doing so, students were able to examine how the educational theories they were studying related to specific classroom practices. Hence students often described the lectorial activities as 'practical' and 'relevant' to their

preparation for teaching. Students also mentioned that there were 'lots of examples', which often took the form of personal anecdotes from the lecturer which were used to illustrate concepts and create a 'positive climate'.

The use of realistic examples helped to motivate students and keep them interested in the content because they saw the nexus between the tasks in which they were involved and the kinds of teaching approaches which they could use in their own teaching: 'It gave me an idea of how to implement lessons more effectively in real situations', and 'I have a better understanding on how to use different methods in teaching.' In other words, the lectorial activities were seen by students as exemplars of constructivist teaching which 'gave me some good ideas for presenting maths in a new way' and 'allowed me to see various ways of approaching the teaching of mathematics'. This made the lectorial activities 'authentic' and provided further impetus for students to become involved because they appreciated the value of the tasks in preparing them for their own classroom teaching.

Some students also reported that the lectorial activities had helped them overcome their negative feelings about the prospect of teaching mathematics and it appeared that, for these students, participation in the lectorial activities had given them the confidence to approach a subject that they had found problematic in the past. As one student wrote,

The activities have helped me to understand and in some sense internalize the ideas and concepts discussed in the lectures and readings. They have also helped me break free from my fear of maths [and] the idea of maths is no longer scary to me and I feel much more confident to experiment.

Discussion and conclusion

The main conclusion to emerge from this study is that the students greatly valued opportunities for cooperative learning and active engagement in lectures, both as a means of improving their understanding of the unit content and in maintaining their interest during the sessions. In particular, students valued the variety of lectorial activities, especially the opportunities for small-group and whole-class discussions, the clear focus on one or two central ideas, and the authenticity of the lectorial tasks, which the students saw as closely related to learning and teaching in actual classrooms. Through their active participation, students were motivated to prepare for the sessions by looking over the lectorial slides and completing the course readings, they were better able to remain focused and attentive throughout the lectorials, and they were sustained in their reflective thinking about the issues raised in lectorials in the days between each class. An overwhelming number of students also agreed with the proposition that cooperative learning activities assisted the development of their understanding of the unit content and helped them to remain focused in lectorials, even during the more traditional stand-and-deliver phases.

These findings are consistent with previous studies which have found that providing opportunities for students to cooperate in peer learning activities during lectures supports the development of their understanding (Hawthorn and Conrad, 1997), that vigilance decrement is avoided when the lecture presentation is varied (Young et al., 2009) and that students are motivated when activities are undertaken collaboratively (McCarthy and Anderson, 2000). However, the results contrast those of van Dijk et al. (1999), who concluded that interactive teaching during lectures did not automatically lead to active student engagement, and of Vreven and McFadden (2007), who discovered no additional benefits for students from cooperative learning activities in lectures.

The noteworthy distinction between the research just cited and the present study is the ways in which the cooperative learning activities were fully integrated into the EDUC258 lectorials. The lectorial structure, in which cooperative learning tasks were incorporated with traditional lecture delivery, helped students to make connections between their cooperative learning and the unit content so that they could readily see the purpose and importance of the group tasks. The study therefore highlights the importance of integrating cooperative learning activities with segments of traditional lecturing so that students are satisfied that there is an appropriate mix of content delivery and active engagement. As a consequence, the students contributed a great deal to the academic rigor of the lectorials, and the lecture phases often served to summarize the key ideas that students had already raised and discussed.

The results also suggest that it was not only the provision of cooperative learning tasks that better allowed students to understand the unit content and maintain their focus, but also the specific nature and design of the activities. The students viewed them as intrinsically valuable because they were authentic. The coherence of the cooperative learning activities was also highlighted by students who commented that the tasks were directly linked to the other lectorial content and additional course materials such as readings. Students observed that the relatively short timeframe allowed for them to complete the cooperative learning activities helped focus their attention and take full advantage of the opportunities the tasks offered for building their understanding of the unit content. Students also noted the legitimacy of a unit which adopted a constructivist stance employing cooperative learning activities to engage students and provide a chance for them to draw on their own experiences in order to build their understanding of the unit content.

It is important to note that the questionnaire was designed only to capture students' perceptions *about* their learning; no attempt was made to investigate the impact of the lectorial activities on how well students actually learned the content. Future studies might therefore measure student understanding before and after completing a unit which incorporates cooperative learning tasks during lectures and compare the results with those from students who had undertaken a unit where only direct instruction techniques were used in lectures. Further research could also supplement students' questionnaire responses by including data from other sources such as focus group interviews. Moreover, since the questionnaire was administered by the unit convenor in the last lecture before the final examination, some students might have felt it was in their best interests to accentuate the positive elements of their experiences, even in responses given anonymously. Hence, data collection might be better conducted after the students receive their final results. Some caution should be exercised in generalizing the findings of the research since it was undertaken with a small sample size from one unit at a single institution. There was also no attempt made to contact students who did not regularly attend lectorials, so it is conceivable that those who found little value in the cooperative learning activities did not complete the questionnaire, possibly skewing the results. Future studies might therefore investigate the views not only of students who attend classes but also of those who listen to audio recordings of lectures via the internet.

It is important to distinguish the activities in which students are engaged from students' experiences of those activities (Kyriacou and Marshall, 1989), and the questionnaire respondents were particularly well placed to do so, given their background in education studies and their previous classroom experiences as pre-service teachers. The students were naturally interested in alternative conceptions of learning and teaching, and were well attuned to identifying and evaluating various pedagogical practices. Hence they were able to examine critically their lectorials from both the learner's and teacher's perspective. As a result, the participants could not only identify the activities that had helped them learn the unit content and remain vigilant during the lectorials, they were also able to justify their claims about the relative merits of the different lectorial activities and teaching approaches. For example, students recognized that the lectorial activities catered for a

range of learning styles and preferences, and that group discussions provided a framework to strengthen their understanding of the unit content; they noted that the activities provided models of constructivist teaching approaches which they could use in their own classrooms; and they valued the coherence of the activities, both in the transitions from traditional lecturing phases to cooperative learning tasks within the lectorials and in terms of the interrelationships among the lectorial activities and other unit content, such as readings and tutorials.

The high rate of lectorial attendance reported by the participants is also noteworthy, particularly since it was not compulsory to be present and all of the lectorials were recorded for audio streaming from the unit website. This is important because students' claims about the perceived motivational and learning benefits of the lectorials would be questionable if so many had not attended so regularly. Moreover, the fact that most students came to the lectorials on a regular basis contradicts the commonly held view reported among academics that students will not attend classes if they can download a recording. The results of the study show that students value face-to-face teaching when it provides opportunities for them to interact in ways that engage them and support their learning – opportunities are not readily available via audio or video recordings.

This research indicates that students do value being productively engaged in lectures and that they will attend non-compulsory lectures even when the sessions are readily available as podcasts, provided they recognize some value in doing so. Clearly, lecture activities need to be thoughtfully designed and carefully implemented if their potential for student learning and motivation is to be fully realized. In particular, the students in this study appreciated the mix of cooperative learning activities which were fully integrated with traditional lecturing methods. The study therefore demonstrates that lectures which include an appropriate balance of direct instruction and student-centred learning activities can address students' concerns about covering sufficient content while at the same time appealing to their desire for fuller engagement in their learning.

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Appendix

2009 Student Survey for Lectorials in EDUC258

Please note:

- This survey is anonymous
- This survey is voluntary and you may choose to answer all, some or none of these questions

How many lectorials have you attended this semester?

- ☐ I have attended all 13 of the lectorials
- ☐ I have been absent for 1 or 2 lectorials
- ☐ I have been absent for 3 or 4 lectorials
- ☐ I have been absent for more than 4 lectorials

The following questions refer to lectorials *which you have attended* (do not refer to any lectorials which you have not attended in person).

- 1 Have the lectorial activities helped you to learn and understand the content presented in the unit?
If so, how? If not, why not?
- 2 Have the lectorial activities helped you to maintain your interest and attention during the sessions?
If so, how? If not, why not?
- 3 Is the number of lectorial activities each week appropriate?
If so, why? If not, why not?
- 4 Do you have any suggestions for increasing student engagement in lectorials? (e.g. activities you think would be helpful; ways of using the activities that would be helpful, etc.)
- 5 Any other comments or suggestions?

Thank you for your time!

Biographical note

Michael Cavanagh works at the Centre for Research in Mathematics and Science Education at Macquarie University in Sydney, Australia. He is a senior lecturer in Mathematics Education and his current research interests include the development of pre-service mathematics teachers' reflective practice and the teaching of algebra. *Address:* Department of Education, Macquarie University, North Ryde 2109, Australia. [email: michael.cavanagh@mq.edu.au]